GeoHealth

Premature Deaths due to Heat Exposure: The Potential Effects of Neighborhood-level Versus City-level Acclimatization Within US Cities

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Introduction

The supporting information includes 5 additional figures and 6 additional tables providing information referred to in the main text. Figures include analyses comparable to those shown in the main text but for additional cities. Tables include analyses comparable to those shown in the main text but for additional years and generalized rather than city-specific risk functions.
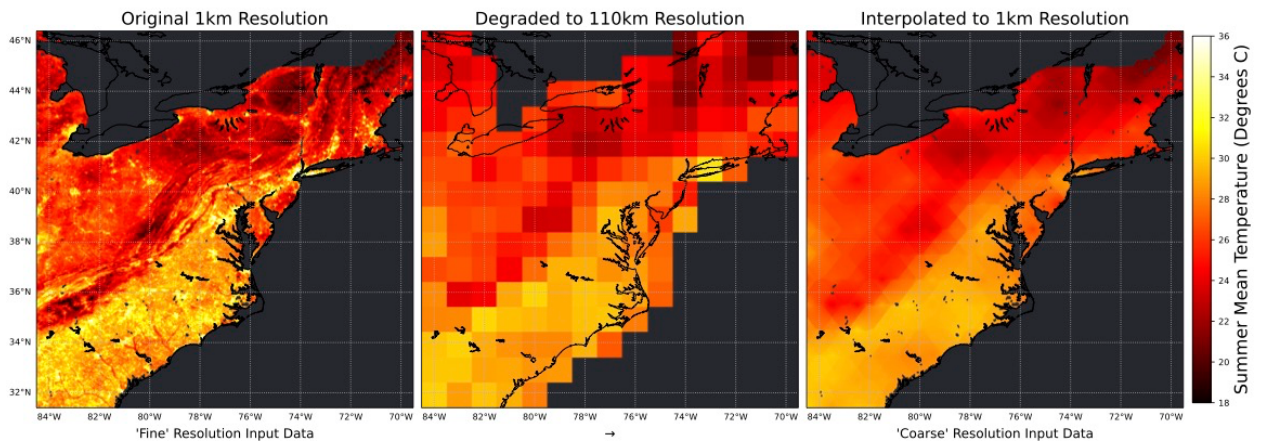
Figure S1. Like Figure 1 but for summer mean temperatures rather than optimum temperatures (used in the generalized equation only).
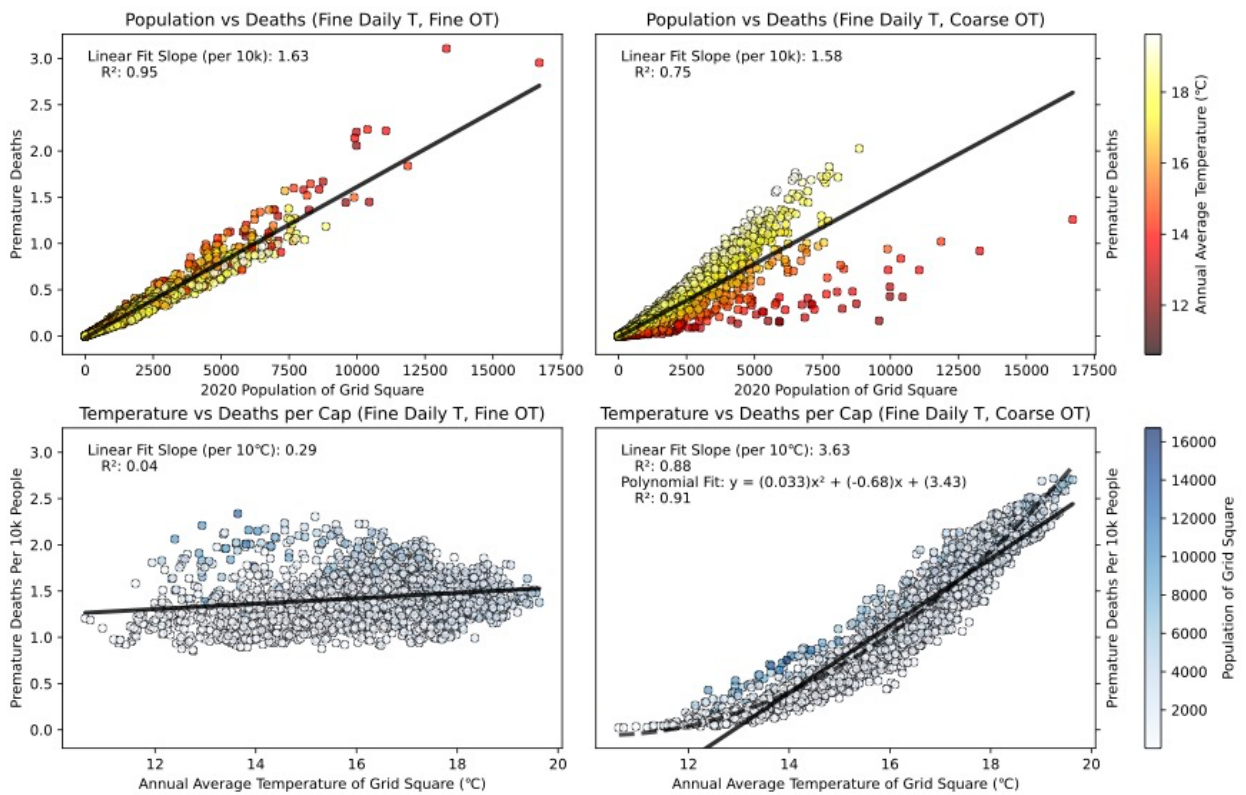

Figure S2. As Figure 3 but regressing deaths against annual average 1x1 km temperature rather than local OT.
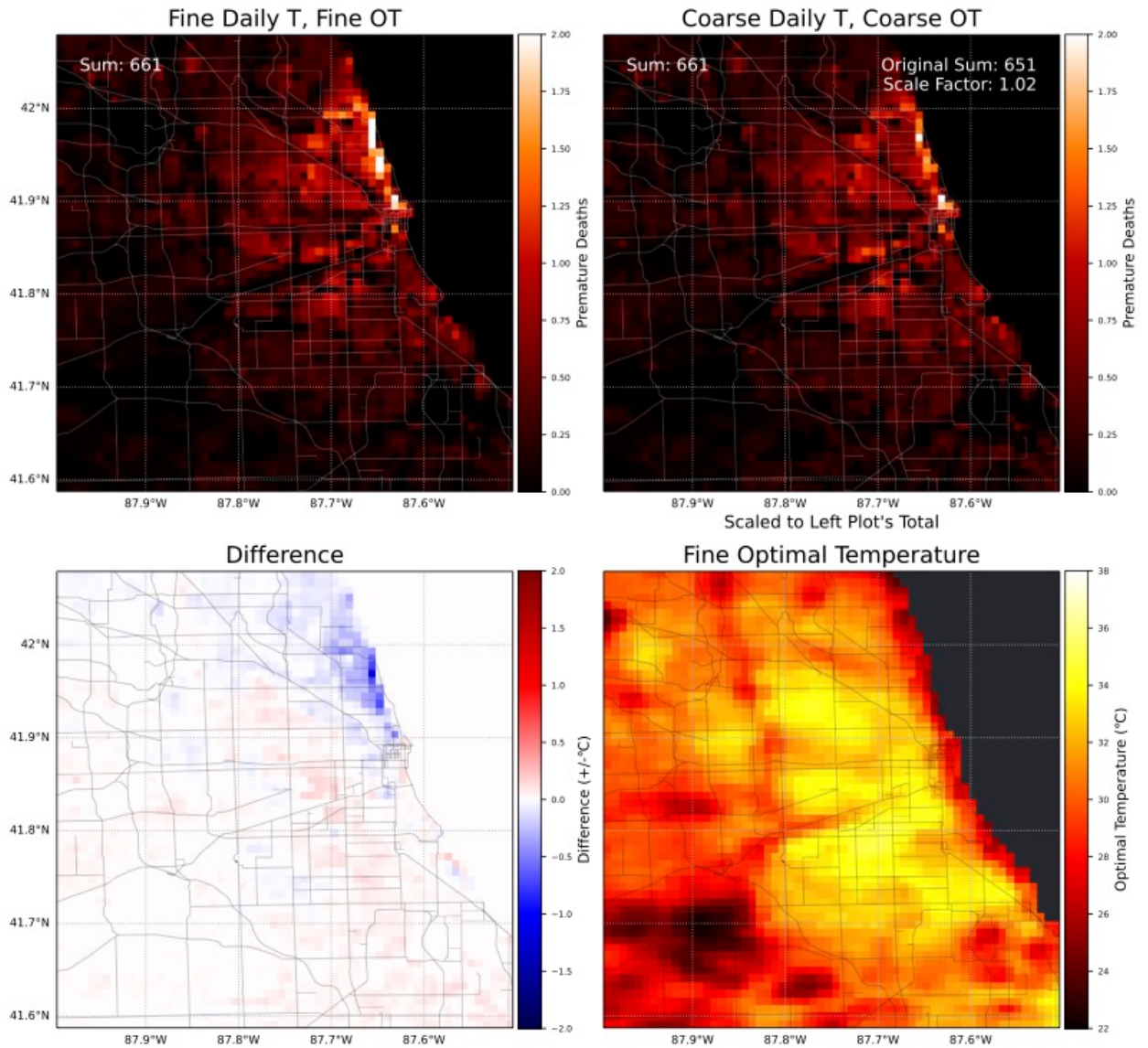
Figure S3. Premature deaths in Chicago attributable to heat exposure in 2019 as in Figure 2 but using coarse daily temperatures in the coarse case. Values cover the 0.5 x 0.5 degree box around the city center and use the 1×1 km neighborhood-level OT and daily temperatures in the fine case (top left) and the city-wide OT and daily temperatures interpolated from 110×110 km in the coarse case (top right) with the difference also shown (lower left) as well as the fine OT (lower right).

Figure S4. As Figure 2 but for Los Angeles.
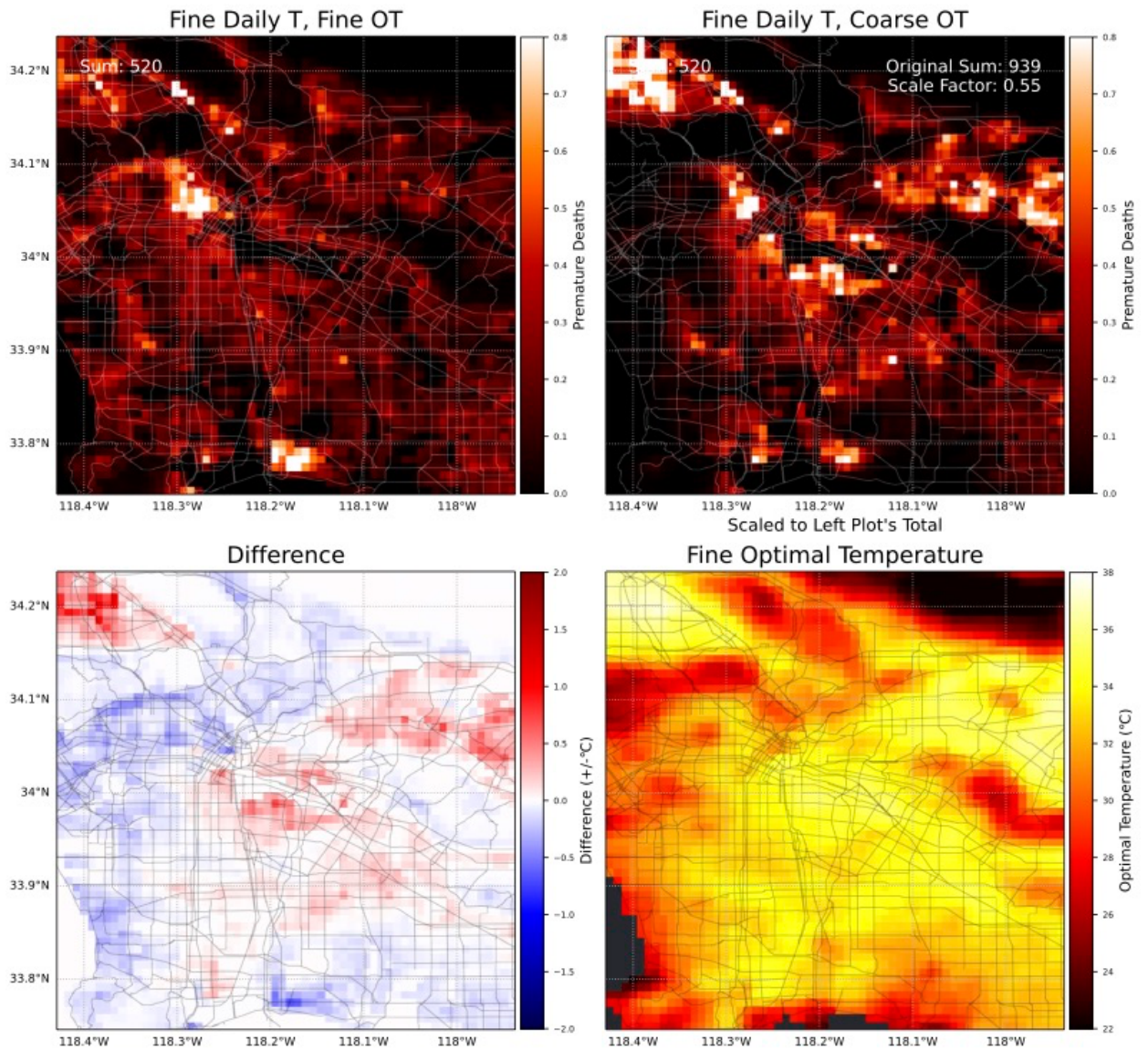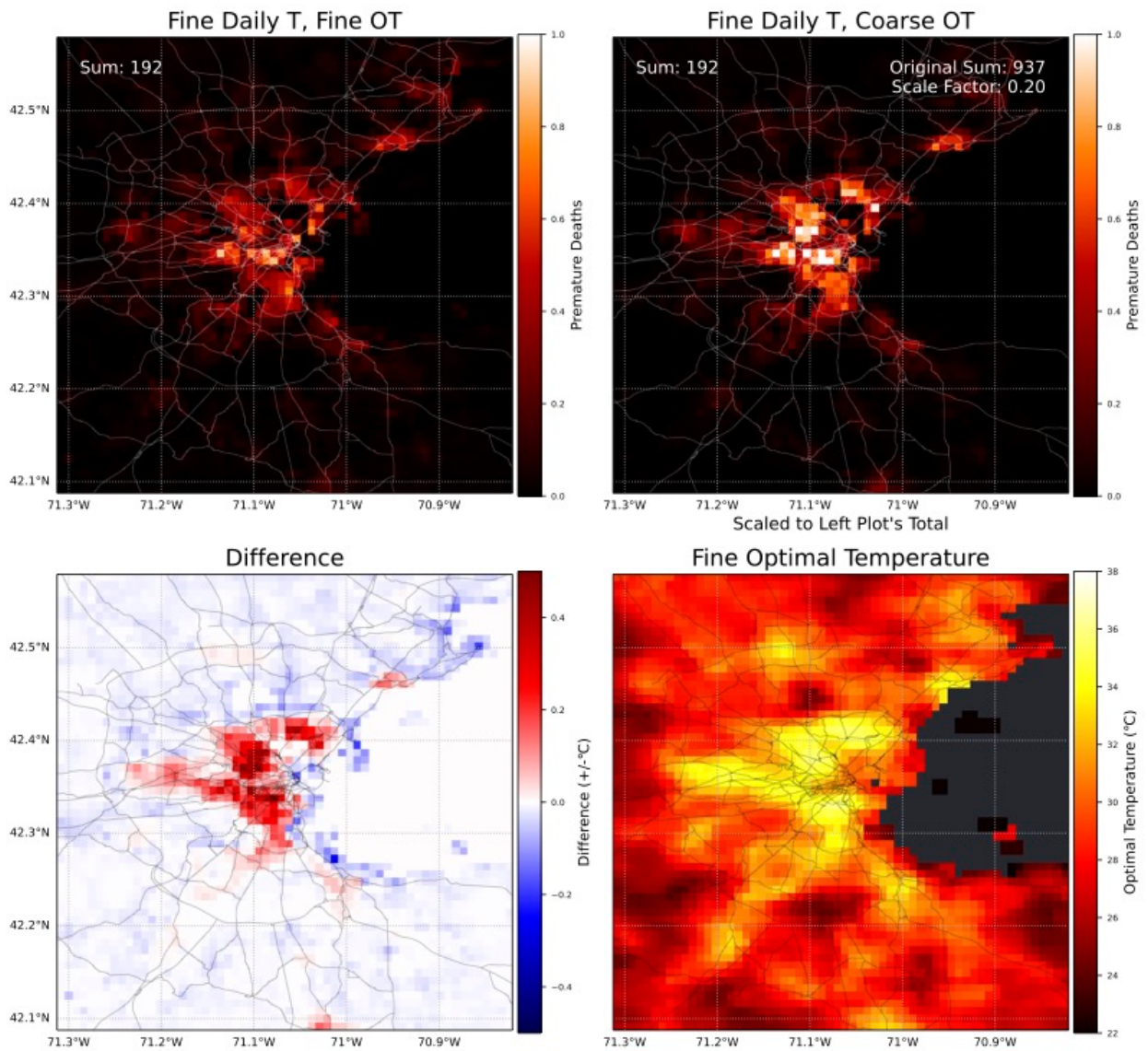
Figure S5. As Figure 2 but for Boston.

Total Projected Premature Deaths by Year (City-Specific Functions)							
		Total Deaths (All Fine Inputs)		Total Deaths (All Coarse Inputs)		Scale Ratio (Fine/Coarse)	
City (0.5°x0.5°)	2020 Population*	2018	2019	2018	2019	2018	2019
Chicago	4,380,919	856	661	735	651	1.16	1.02
Los Angeles	7,592,650	952	520	886	507	1.07	1.03
Houston	3,749,665	304	279	188	142	1.62	1.96
New York	9,949,161	633	730	395	405	1.60	1.80
Atlanta	2,536,008	149	164	83	108	1.80	1.52
Miami	2,589,070	115	118	71	83	1.62	1.42
Dallas	3,326,803	81	59	66	34	1.23	1.74
Philadelphia	3,466,751	124	121	94	71	1.32	1.70
DC	3,318,544	345	252	204	121	1.69	2.08
Boston	2,613,995	152	192	94	111	1.62	1.73
Total/Average	43,523,566	3711	3096	2816	2233	1.47	1.60

Table S1. Comparable results for 2018 and 2019 temperatures. *Population only includes the grid boxes which have been actually calculated for mortality, and populations within a given city may be lower than the actual population as some coastal areas do not have data in the MODIS product.

City (0.5°x0.5°)	Projected Deaths per Million People		Weinberger Projected Deaths per Million People (RCP 8.5)		Difference from Median of Weinberger Range	
	All Fine Inputs	All Coarse Inputs	1997	2050	All Fine Inputs	All Coarse Inputs
Chicago	150.88	148.6	38.93	219.35	21.74	19.46
Los Angeles	68.49	66.78	54.89	294.06	-105.98	-107.69
Houston	74.41	37.87	0.68	29.95	59.09	22.55
New York	73.37	40.71	76.85	246.98	-88.55	-121.21
Atlanta	64.67	42.59	2.57	40.38	43.20	21.12
Miami	45.58	32.06	19.46	92.20	-10.25	-23.77
Dallas	17.73	10.22	16.78	74.63	-27.97	-35.48
Philadelphia	34.9	20.48	52.00	150.54	-66.37	-80.79
DC	75.94	36.46	4.13	52.15	47.80	8.32
Boston	73.4	42.43	15.80	72.51	29.24	-1.73
Average	67.94	47.82	28.21	127.27	-9.80	-29.92
Chicago	69.39	82.17	38.93	219.35	-59.75	-46.97
Los Angeles	52.29	50.97	54.89	294.06	-122.18	-123.50
Houston	50.94	31.74	0.68	29.95	35.62	16.42
New York	61.11	66.74	76.85	246.98	-100.81	-95.18
Atlanta	55.6	41.4	2.57	40.38	34.13	19.93
Miami	51.76	23.17	19.46	92.20	-4.07	-32.66
Dallas	58.31	49.3	16.78	74.63	12.61	3.60
Philadelphia	60	37.79	52.00	150.54	-41.27	-63.48
DC	53.64	31.04	4.13	52.15	25.50	2.90
Boston	74.22	74.22	15.80	72.51	30.06	30.06
Average	58.73	48.85	28.21	127.27	-19.02	-28.89

Title (spanning table top): Projected Per Capita Mortality vs Weinberger et al (2017) Projected Range

Table S2. Per capita deaths by city for 2019 (first two columns) and compared with the median of 1997 and 2050 projections under RCP8.5 from Weinberger et al (2017), hence around 2023 whereas our values are for the year 2019. Values in the upper half of the table use the city-specific epidemiological functions of Weinberger et al (2017) whereas those in the lower half use the generalized functions of Shindell et al (2020). Our values are for the 0.5 x 0.5 degree box around the city center.

	Annual Average Temp vs Projected Deaths per 10k People					
	All Fine Inputs		All Coarse Inputs		Fine Daily T, Coarse OT/SMT	
City (0.5°x0.5°)	Slope (per 10°C)	R^2	Slope (per 10°C)	R^2	Slope (per 10°C)	R^2
Chicago	0.29	0.04	-0.05	0.07	3.63	0.88
Los Angeles	-0.25	0.08	-0.03	0.02	2.49	0.56
Houston	0.13	0.03	-0.09	0.28	1.54	0.84
New York	0.17	0.05	-0.07	0.07	2.13	0.88
Atlanta	0.28	0.10	-0.02	0.01	2.99	0.91
Miami	0.05	0.05	-0.00	0.00	0.81	0.99
Dallas	0.09	0.13	0.01	0.04	0.48	0.83
Philadelphia	0.19	0.32	0.01	0.04	0.99	0.88
DC	0.37	0.15	-0.01	0.04	2.29	0.89
Boston	0.37	0.23	-0.01	0.00	1.62	0.88
Average	0.17	0.12	-0.03	0.06	1.89	0.85

Title above table: Annual Avg Temperature vs 2019 Projected Premature Deaths (City-Specific Functions)

Table S3. Regression of premature deaths per 10,000 persons versus annual average temperatures (rather than versus OT as in Table 1).

City (0.5°x0.5°)	Population/Temperature vs Projected Premature Deaths (Generalized Function)											
	Population vs 2019 Calculated Deaths						Optimal Temperature vs 2019 Calculated Deaths per 10k People					
	All Fine Inputs		All Coarse Inputs		Fine Daily T, Coarse OT & SMT		All Fine Inputs		All Coarse Inputs		Fine Daily T, Coarse OT & SMT	
	Slope (per 10k people)	R^2	Slope (per 10k people)	R^2	Slope (per 10k people)	R^2	Slope (per 10°C)	R^2	Slope (per 10°C)	R^2	Slope (per 10°C)	R^2
Chicago	0.75	0.92	0.69	1.00	0.73	0.74	-0.18	0.20	-0.02	0.26	1.18	0.93
Los Angeles	0.52	0.97	0.52	1.00	0.56	0.68	0.06	0.05	0.00	0.00	1.24	0.88
Houston	0.52	0.99	0.51	1.00	0.63	0.88	0.07	0.08	-0.03	0.19	0.88	0.89
New York	0.61	0.97	0.56	1.00	0.56	0.82	-0.31	0.57	-0.02	0.07	1.09	0.88
Atlanta	0.57	0.98	0.56	1.00	0.82	0.72	0.11	0.11	-0.01	0.03	1.63	0.93
Miami	0.54	0.97	0.52	1.00	0.57	0.71	0.28	0.72	-0.01	0.01	0.95	0.92
Dallas	0.59	0.99	0.59	1.00	0.67	0.91	0.16	0.46	0.03	0.12	0.97	0.94
Philadelphia	0.59	0.99	0.60	1.00	0.92	0.88	0.04	0.02	0.01	0.04	1.15	0.93
DC	0.55	0.99	0.54	1.00	0.69	0.85	0.17	0.35	-0.00	0.01	1.09	0.95
Boston	0.60	0.92	0.74	1.00	1.04	0.92	-0.38	0.38	0.00	0.00	1.10	0.93
Average	0.58	0.97	0.58	1.00	0.72	0.81	0.00	0.29	-0.01	0.07	1.13	0.92

Table S4. As Table 2 but for the generalized exposure-response functions.

City (0.5°x0.5°)	Annual Average Temperature vs 2019 Projected Premature Deaths (Generalized Function)					
	Annual Average Temp vs Projected Deaths per 10k People					
	All Fine Inputs		All Coarse Inputs		Fine Daily T, Coarse OT/SMT	
	Slope (per 10°C)	R^2	Slope (per 10°C)	R^2	Slope (per 10°C)	R^2
Chicago	-0.29	0.23	-0.03	0.18	1.69	0.86
Los Angeles	0.03	0.01	-0.01	0.03	1.30	0.77
Houston	0.08	0.07	-0.04	0.25	1.00	0.87
New York	-0.46	0.55	-0.03	0.08	1.65	0.89
Atlanta	0.17	0.14	-0.01	0.02	2.32	0.92
Miami	0.32	0.69	-0.00	0.00	1.10	0.94
Dallas	0.19	0.45	0.04	0.15	1.19	0.94
Philadelphia	0.09	0.04	0.02	0.06	1.70	0.89
DC	0.26	0.36	0.00	0.00	1.54	0.90
Boston	-0.59	0.43	-0.01	0.00	1.59	0.92
Average	-0.02	0.30	-0.01	0.08	1.51	0.89

Table S5. As Table S3 but using the generalized equations (i.e., for comparison with Table S4).

15th Percentile OT Areas vs Projected 2019 Per Capita Premature Deaths (Generalized Function)				
	Premature Deaths per 1 Mil People in the Coldest 15th Percentile Grid Boxes		Premature Deaths per 1 Mil People in the Hottest 15th Percentile Grid Boxes	
City (0.5°x0.5°)	All Fine Inputs	Fine Daily T, Coarse OT/SMT (Scaled)	All Fine Inputs	Fine Daily T, Coarse OT/SMT (Scaled)
Chicago	88	16	59	103
Los Angeles	48	2	56	94
Houston	51	8	52	72
New York	81	15	54	110
Atlanta	51	11	56	108
Miami	35	7	56	81
Dallas	52	12	60	77
Philadelphia	60	9	58	93
DC	46	7	55	83
Boston	101	11	59	105
Average	61	10	57	93

Table S6. As Table 1 but for the generalized equations.